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Attention: Examiner: Rajeev Deshmukh

Dear Sir

Re: International Patent Application No. ~~2004900118~~ PCT/AU03/00730 in the name of Securency Pty Limited

We refer to the Written Opinion dated 20 January 2004 on this application and enclose substitute pages 2-5b of the specification and 11-17 of the claims to replace pages 2-5 and 11-16 of the specification and claims presently on file in this application.

In the substitute claims, claim 1 has been amended to include the subject matter of original claims 4 and 7 and now recites that "the latent image comprises a pattern formed in the at least one photo-alignment layer and/or in the liquid crystal layer without the use of a mask".

A new independent claim 2 has been introduced which recites that the latent image is "formed by image areas and/or non-image areas written in the at least one photo-alignment layer and/or the liquid crystal layer". New dependent claim 3 recites that the pattern forming the latent image is "laser written" into the photo-alignment layer and/or in the liquid crystal layer, and new dependent claim 4 recites that the image areas and/or non-image areas are "removed by laser ablation".

New dependent claims 5, 6 and 7, 8 correspond to original claims 2, 3 and 5 and 6. Dependent claims 9 through 20 correspond to original claims 8 through 19.

Independent method claim 21 has been amended in similar manner to claim 1. New dependent claim 22 corresponds to original claim 30.

A new independent method claim 23 directed to forming the latent image in the at least one photo-alignment layer and/or the liquid crystal layer "by writing image areas or non-image areas in at least one of said layers" has been included corresponding to the second paragraph on page 4 of the specification as filed.

Dependent claim 24 which states that "a laser is used to write the image areas and/or

non-image areas" corresponds to original claim 31. New dependent claims 25-28 correspond to original claims 35-38. New dependent claims 29-31 correspond to original claims 32-34. New dependent claims 32-40 correspond to original claims 21-29, and new claims 41 through 50 correspond to original claims 39 through 48.

It is noted that the Examiner only objected to the novelty and inventive step of original claims 1 and 20, and considered that all of the dependent claims satisfied the requirements of novelty and inventive step. As amended claims 1 and 20 have been amended to incorporate features of dependent claims as originally filed, it is submitted that those claims are novel and involve an inventive step having regard to the cited references.

It is also submitted that independent claims 2 and 23 also involve an inventive step having regard to the cited references, none of which discloses the formation of a latent image in a photo-alignment layer or in a liquid crystal layer by writing image areas or non-image areas in at least one of the layers.

In view of the observations which have been made, favourable reconsideration of this application is requested.

Yours respectfully
WATERMARK

J Roger Green

US 5 678 863 discloses a means of identification or a document of value which has a cholesteric liquid crystal material applied to a watermark in a transparent or translucent region so that the watermark changes colour under different viewing conditions. In order to form an image in a different colour, it si necessary to use two cholesteric liquid crystals which are chosen so as to produce alternatively right and left polarising light. A layer formed from such liquid crystals is quite thick and the liquid crystal materials are relatively expensive. Such a latent image is only circularly polarising in reflection and requires a circular polariser for viewing the colour changing effect.

It is therefore desirable to provide a polarising liquid crystal device which can be used to form variable latent images that can be readily varied for incorporation in different security devices and security documents.

It is also desirable to provide relatively simple and effective methods of manufacturing such polarising liquid crystal devices for forming a latent image in a security document.

According to one aspect of the invention, there is provided a liquid crystal device comprising: a substrate; at least one photo-alignment layer applied to the substrate and which is uniformly aligned with a polarised light source; a nematic liquid crystal layer applied to the photo-alignment layer; and a latent image formed by the photo-alignment layer and the liquid crystal layer, wherein the latent image comprises a pattern formed in the at least one photo-alignment layer and/or in the liquid crystal layer.

Preferably, the latent image may be written into the at least one photo-alignment layer and/or the liquid crystal layer.

According to a second aspect of the invention there is provided a liquid crystal device comprising:

a substrate;

at least one photo-alignment layer applied to the substrate and which is uniformly aligned with a polarised light source;

a nematic liquid crystal layer applied to the photo-alignment layer; and

a latent image viewable under cross-polarisers formed in the at least one photo-alignment layer and/or the liquid crystal layer,

wherein the latent image is formed by image areas and/or non-image areas written in the at least one photo-alignment layer and/or the liquid crystal layer.

The pattern forming the latent image is preferably laser written into the photo-alignment layer and/or the liquid crystal layer, *eg* by a variable laser writing process.

In one preferred embodiment, the latent image is formed by image areas and/or non-image areas of the photo-alignment layer and/or the liquid crystal layer removed by laser ablation.

At least one of the at least one photo-alignment layer and/ or the liquid crystal layer may be a printed layer. The printed layer or layers may be applied to the substrate by a variable printing process, for example using ink jet printing or other variable printing technology which allows a latent image to be formed in the at least one photo-alignment layer and/or in the liquid crystal layer.

According to a third aspect of the invention, there is provided a method of manufacturing a liquid crystal device comprising:

applying at least one photo-alignment layer to a substrate;

uniformly aligning the photo-alignment layer with a polarised light source;

applying a liquid crystal layer to the photo-alignment layer; and

forming a pattern representing a latent image in the at least one photo-alignment layer and/or the liquid crystal layer without the use of a mask.

Preferably, the latent image is formed in the at least one photo-alignment layer and/or the liquid crystal layer by writing or printing the image in at least one of said layers.

According to a fourth aspect of the invention, there is provided a method of manufacturing a liquid crystal device comprising:

applying at least one photo-alignment layer to a substrate;

uniformly polarising the photo-alignment layer with a polarised light source;

applying a liquid crystal layer to the photo-alignment layer; and

forming a latent image in the at least one photo-alignment layer and/or the liquid crystal layer by writing image areas or non-image areas in at least one of said layers.

In preferred embodiments, lasers may be used to write image areas and/or non-image areas in the at least one photo-alignment layer or in the liquid crystal layer.

In a particularly preferred embodiment, a laser may be used to remove non-image areas of the uniformly aligned photo-alignment layer and/or the liquid crystal layer. The laser should be of sufficient strength so as to ablate non-image areas of the photo-alignment layer and/or the liquid crystal layer, rather than reversing the polymerisation state.

In another embodiment of this aspect of the invention, a photo-alignment layer is applied over the entire area of the substrate forming the device and is uniformly aligned with polarised light. An ultraviolet (UV) laser is used to change the photo-aligned polarisation state either in areas which are to form the latent image or in non-image areas. Preferably, the UV laser has a wavelength of 280nm or less. The nematic liquid crystal can then be applied in a pattern representing the latent image.

In a further embodiment, the latent image may be at least partly formed by applying the liquid crystal layer to a uniformly aligned photo-alignment layer in a pattern representing the latent image. The photo-alignment area may be applied over the entire area of the substrate which forms the security device.

In another embodiment, the latent image may be at least partly formed by the photo-alignment layer which is applied to the substrate in a pattern representing the latent image. The liquid crystal layer can then be applied over the entire area of the device.

In a further embodiment, the latent image may be formed by a second photo-alignment layer which is applied to a uniformly aligned first photo-alignment layer covering the entire area of the device. The second alignment layer is applied, preferably by printing only, in a pattern representing the latent image, and is aligned with polarised light at a different angle to the polarised light which is used to align the uniformly aligned first photo-alignment layer. The nematic liquid crystal layer may then be applied to the second photo-alignment layer, preferably also in the pattern representing the desired latent image.

In each of the embodiments above, the liquid crystal layer may be fixed by a curing process, e.g. with UV radiation.

The polarising liquid crystal device may include further layers. For instance, in some embodiments a coating may be applied over the liquid crystal

layer, preferably so as to provide a device of uniform height. Preferably, the coating has a refractive index which matches the refractive index of the liquid crystal layer to hide the latent image.

According to a further aspect of the invention, there is provided a security document incorporating a polarising liquid crystal device in accordance with the first or second aspects of the invention.

According to yet another aspect of the invention there is provided a polarising liquid crystal device manufactured according to either the method of the third aspect or the method of the fourth aspect of the invention.

According to a still further aspect of the invention there is provided a security document incorporating a liquid crystal device manufactured in accordance with either the method of the third aspect or the method of the fourth aspect of the invention.

As used herein, the term "security documents or tokens" includes documents such as identity documents; value documents; or entrance documents, which in turn respectively include: passports, visas, identity cards, drivers licences, and security entrance cards; banknotes, shares, bonds, certificates, cheques, lottery tickets, bank cards, charge cards and credit cards; and aeroplane tickets, bus tickets, railroad tickets, and tickets to fun parks or specific rides.

The polarising liquid crystal devise of the present invention may be used to provide variable latent images of different forms in a wide variety of security documents. For example, a latent image in the form of a portrait of a cardholder may be provided in an identity card, a credit card or the like, so that the identity of the cardholder can be verified by viewing the latent image under cross-polarizers.

The present invention, which does not require separate exposures to polarised light using a mask, enables the latent image to be varied for different

applications, for example, in a variable printing process and/or in a laser writing process.

Any discussion of documents, devices, acts or knowledge in this specification is included to explain the context of the invention. It should not be taken as an admission that any of the material formed part of the prior art base or the common general knowledge in the relevant art on or before the priority date of the claims herein.

"Comprises/comprising" when used in this specification is taken to specify the present of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof".

CLAIMS:

1. A liquid crystal device comprising:

a substrate;

at least one photo-alignment layer applied to the substrate and which is uniformly aligned with a polarised light source;

a nematic liquid crystal layer applied to the photo-alignment layer; and

a latent image formed by the photo-alignment layer and the liquid crystal layer wherein the latent image comprises a pattern formed in the at leat one photo-alignment layer and/or in the liquid crystal layer without the use of a mask and the latent image is viewable under cross-polarisers.

2. A liquid crystal device comprising:

a substrate;

at least one photo-alignment layer applied to the substrate and which is uniformly aligned with a polarised light source;

a nematic liquid crystal layer applied to the photo-alignment layer; and

a latent image viewable under cross-polarisers formed in the at least one photo-alignment layer and/or the liquid crystal layer,

wherein the latent image is formed by image areas and/or non-image areas written in the at least one photo-alignment layer and/or the liquid crystal layer.

3. A liquid crystal device according to claim 1 or claim 2 wherein a pattern forming the latent image is laser written into the photo-alignment layer and/or in the liquid crystal layer.

4. A liquid crystal device according to claim 2 or claim 3 wherein the latent image is formed by image areas and/or non-image areas of the photo-alignment layer and/or the liquid crystal layer removed by laser ablation.

5. A liquid crystal device according to claim 1 or claim 2 wherein the at least one photo-alignment layer is a printed layer.

6. A liquid crystal device according to claim 1 or claim 2 wherein the liquid crystal layer is a printed layer.

7. A liquid crystal device according to claim 1 wherein the photo-alignment layer is printed on the substrate in the pattern forming the latent image.

8. A liquid crystal device according to any one of the preceding claims wherein the liquid crystal layer covers the substrate in the entire area of the device.

9. A liquid crystal device according to claim 1 wherein the liquid crystal layer is printed on the photo-alignment layer in the pattern forming the latent image.

10. A liquid crystal device according to claim 9 wherein the photo-alignment layer covers the substrate in the entire area of the device.

11. A liquid crystal device according to claim 1 wherein a uniformly aligned first photo-alignment layer covers the substrate in the entire area of the device, the latent image is formed by a pattern in a second photo-alignment layer applied to the first photo-alignment layer, and the liquid crystal layer covers at least the second photo-alignment layer.

12. A liquid crystal device according to claim 11 wherein the second photo-alignment layer is printed on the first photo-alignment layer in the pattern forming the latent image.

13. A liquid crystal device according to claim 11 or claim 12 wherein the liquid crystal layer is applied to the second photo-alignment layer in the pattern representing the latent image.

14. A liquid crystal device according to claim 3 wherein the latent image is laser written into the at least one photo-alignment layer.

15. A liquid crystal device according to claim 11 wherein the latent image is laser-written into the second photo-alignment layer.

16. A liquid crystal device according to claim 3 wherein the latent image is laser written into the liquid crystal layer.

17. A liquid crystal device according to any one of the preceding claims wherein the liquid crystal layer is fixed by curing.

18. A liquid crystal device according to any one of the preceding claims which includes a coating over the liquid crystal layer.

19. A liquid crystal device according to claim 17 wherein the coating has a refractive index which substantially matches the refractive index of the liquid crystal layer.

20. A liquid crystal device according to claim 18 or claim 19 wherein the coating covers the liquid crystal layer in such a manner to provide a device of substantially uniform height.

21. A method of manufacturing a polarising liquid crystal device comprising:

applying at least one photo-alignment layer to a substrate;

uniformly aligning the photo-alignment layer with a polarised light source;

applying a liquid crystal layer to the photo-alignment layer; and

forming a pattern representing a latent image in the at least one photo-alignment layer and/or the liquid crystal layer without the use of a mask.

22. A method according to claim 20 including the step of writing image areas and/or non-image areas in at least one of the layers.

23. A method of manufacturing a liquid crystal device comprising:

applying at least one photo-alignment layer to a substrate;

uniformly polarising the photo-alignment layer with a polarised light source;

applying a liquid crystal layer to the photo-alignment layer; and

forming a latent image in the at least one photo-alignment layer and/or the liquid crystal layer by writing image areas or non-image areas in at least one of said layers.

24. A method according to claim 22 or claim 23 wherein a laser is used to write the image areas and/or non-image areas.

25. A method according to claim 24 wherein a laser is used to remove image areas or non-image areas of the at least one photo-alignment layer and/or the liquid crystal layer.

26. A method according to claim 25, wherein the uniformly aligned photo-alignment layer is applied over the substrate in the entire area of the device, and the laser is used to ablate non-image areas of the photo-alignment layer to leave non-ablated image areas.

27. A method according to claim 25 wherein the liquid crystal layer is applied to the non-ablated image areas of the photo-alignment layer in the pattern representing the latent image.

28. A method according to claim 25 wherein the laser is used to ablate non-image areas of the liquid crystal layer to leave non-ablated image areas in a pattern forming the latent image.

29. A method according to claim 24 wherein the uniformly aligned photo-alignment layer is applied over the substrate in the entire area of the device, and a UV laser is used to change the photo-alignment state of the photo-alignment layer in the image areas and/or non image areas.

30. A method according to claim 29 wherein the UV laser has a wavelength of about 280 nm or less.

31. A method according to claim 29 or claim 30 wherein the liquid crystal layer is applied to the photo-alignment layer in a pattern representing the latent image.

32. A method according to claim 20 including the step of printing the latent image in at least one of the layers.

33. A method according to claim 32 including the step of printing the liquid crystal layer in a pattern representing the latent image.

34. A method according to claim 33 including the step of applying the photo-alignment layer over the substrate in the entire area of the liquid crystal device before the liquid crystal layer is applied in the pattern.

35. A method according to claim 32 including the step of printing the photo-alignment layer on the substrate in a pattern representing the latent image.

36. A method according to claim 35 including the step of applying the liquid crystal area over the entire area of the liquid crystal device.

37. A method of manufacturing a polarising liquid crystal device comprising:

applying a first photo-alignment area to cover the substrate over the entire area of the device;

uniformly aligning the first photo-alignment layer with polarised light;

applying a second photo-alignment layer in a pattern representing the latent image;

aligning the second photo-alignment layer with polarised light at an angle different to the alignment of the first photo-alignment layer; and

applying the nematic liquid crystal layer to the second alignment layer in the pattern representing the latent image.

38. A method according to claim 37 wherein the second photo-alignment is printed on the first photo-alignment layer.

39. A method according to claim 37 or claim 38 wherein the liquid crystal layer is printed on the second photo-alignment layer.

40. A method according to any one of claims 20 to 39 wherein a variable printing process is used to print the at least one photo-alignment layer and/or the liquid crystal layer.

41. A method according to any one of claims 20 to 40 further including the step of fixing the liquid crystal layer by a curing process.

42. A method according to claim 41 wherein UV radiation is used to cure the liquid crystal layer.

43. A method according to any one of claims 20 to 42 including the step of applying a coating over the liquid crystal layer.

44. A method according to claim 43 wherein the coating has a refractive index which substantially matches the refractive index of the liquid crystal layer.

45. A method according to claim 43 or claim 44 wherein the coating is applied over the liquid crystal layer so as to provide a liquid crystal device of substantially uniform height.

46. A polarising liquid crystal device manufactured by the method of any one of claims 21 to 45.

47. A security document or token incorporating a polarising liquid crystal device in accordance with any one of claims 1 to 20 or claim 46.

48. A security document or token according to claim 47 wherein the latent image is a portrait corresponding to the holder of the security document.

49. A security document or token according to claim 47 or claim 48 wherein the polarising liquid crystal device containing the latent image is provided in a window of the security document.

50. A security document or token according to any one of claims 42 to 49 wherein the document includes cross-polarisers in a window for verifying the latent image formed by the polarising liquid crystal device.